Point new way to bridge safety

Advanced anti-collision system for bridges over waterways

Every year there are hundreds of collisions between bridges and ships around the world. A collision can bring down part of a bridge or cause hidden damage to the bridge structure. A structural failure in bridges can lead to traffic accidents and fatalities, a risk that should be avoided. Is there any preventive way to protect bridges from dangerous collisions? A new anti-collision system developed by experts from the Department of Civil and Environmental Engineering has great potential. The system can monitor marine traffic, alert for an imminent collision as well as visualise any structural damage. It will bring bridge safety to a whole new level.

A recent bridge collapse in the United State of Missouri has raised concerns over safety. In that accident a road bridge collapsed after the supporting pillars were hit by a derailing cargo train. Equally, bridges over waterways are prone to collisions with passing ships. The collision probability grows as modern ships are getting bigger and bigger. A new solution has been developed by experts from The Hong Kong Polytechnic University, who wanted to advance bridge safety with their newest knowledge in structural health monitoring.

A new surveillance technology from the Department of Civil and Environmental Engineering aims to protect sea bridges from dangerous collision with ships. The anti-collision system can actively scan the open water and send alert to approaching vessels to avoid a collision. To accomplish this, the experts brought together an array of technologies including on-bridge camera systems, pattern recognition technology, structural monitoring technology and marine communication systems.

The camera systems literally give a pair of eyes to the bridge. Based on camera images sophisticated pattern recognition technology is in use to identify a moving vessel and its path. Ultimately, the new system can lock in on an object from a distance, track down its movements and even calculate the speed at which it is approaching the bridge.

When it detects a ship entering the surveillance areas, calculations will be done in real-time to assess the collision risk. When the system determines there is a risk of collision, it will send alert to the trespassing vessel through a marine communication system.

This innovative anti-collision system is developed by a team of experts led by Professor Yiqing Ni (third on the left hand side) from the Department of Civil and Environmental Engineering
giving the ship a chance to dodge out of the way. The bridge owner will also be warned of an imminent collision so that they can make plan for evacuation.

This novel system functions as a ‘black box’ to provide a full record of ship activities and destructive impact on bridge structure. The information will be very useful for investigation and litigation in case of an accident.

Furthermore, post-disaster planning can be more reliable. Principal investigator Professor Yiqing Ni shared, “There are hundreds of ship-bridge collision accidents worldwide every year. This kind of accidents can cause collapse of bridge spans and traffic accidents. More often, they lead to invisible structural damage that may bring about hidden danger threatening bridge safety. As a result, damage assessment is of great importance.” Piezoelectric sensors are laid around to sense the impact forces from ship-bridge collision. Highly sophisticated numerical simulations have also been developed to evaluate the bridge response to impact. According to Prof. Ni, the distribution of stress can be visualised, along with structural damage to the bridge.

Barrier systems are common method to protect the bridges. Protective islands or guide structures are built around bridge piers to withstand a collision or guide ships away from the piers. These solutions often mean huge costs and they also narrow the navigable channels under the bridge. Prof. Ni added, “Our system is more cost-effective when compared with common passive protections against ship collision. Ships will also enjoy good protection without having hi-tech navigation equipment on board.”

The team has won a number of international awards including a Gold Medal at the 41st International Exhibition of Inventions of Geneva and a Special Prize of State Agency for Intellectual Property in the Republic of Moldova in 2013 for their practical designs.